

**The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD – this document) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.**

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## **PROGRAM DESCRIPTION**

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Tennessee Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2014.

## **PROGRAM GOALS**

**Diversity:** "Our goal for the coming five year grant period has been for our percentage of awardees who are members of underrepresented groups in our Fellowship/Scholarship, Research Infrastructure and Higher Education programs to meet or exceed the percentage of students from underrepresented groups who are enrolled in Tennessee colleges and universities. According to the National Center of Education Statistics Digest, Tennessee's underrepresented population enrolled in colleges during the fall of 2007 was 21.9 percent. Thus, during the coming grant period, we will aim to have at least 21.9 percent of our students in the areas listed above be members of underrepresented groups. Additionally, we will aim to have at least 20 percent women awardees in these areas.

Another goal is to keep up our excellent relationship with our two HBCU affiliate institutions and explore the addition of more HBCU schools."

**Specific:** Continued participation of our current HBCU Affiliates.

Measurable: Are Fisk and Tennessee State still Affiliates in good standing?  
Appropriate: Working with these three institutions fits in well with Space Grant's emphasis on partnerships with minority institutions.  
Realistic: Fisk and TSU are already active participants in the TSGC.  
Time-Specific: Whether Fisk and TSU are still active participants at the end of the coming grant year.

**Fellowship/Scholarship**: "Our goal, as per the PART Measures, is to have at least 60 percent of our overall Fellowship/Scholarship graduate students join the STEM workforce when their educations are complete. Also, we aim to have 45 percent of our undergraduate participants pursue further STEM education."

Specific: Assist a diverse group of STEM undergraduate and graduate students with their educational funding.

Measurable: Percentage of our F/S students who pursue further STEM education and careers. (As stated above, 60 percent for graduate and 45 percent for undergraduate.)

Appropriate: Our F/S programs fit in well with NASA Education Outcome and Objective 1.2- Student Support.

Realistic: We have sufficient funding set aside in our budget to fund approximately 25 students in the upcoming grant year.

Time-Specific: We will know whether we have met our goals when each F/S student finishes their current degree and moves on to their next step.

**Research Infrastructure**: "Our goal for these programs is both to further scientific knowledge in areas of interest to NASA and to give undergraduate and graduate students the opportunity to participate in an actual research experience. We will assess these projects based on whether they produce any papers and/or presentation and whether participating students continue on a STEM path."

Specific: Create and maintain a Research Infrastructure program that fits in with NASA scientific priorities and enable students to experience actual scientific research.

Measurable: Our goal is for 75 percent of our RI students to pursue further STEM education and careers. At least three publications/conference presentations that are the direct result of the program.

Appropriate: Our RI program is composed of projects that fit directly into NASA scientific priorities.

Realistic: We have sufficient funding set aside in our budget to fund the research projects proposed for the coming grant year.

Time-Specific: We will know whether we have met our goals when each participating student finishes their current degree and moves on to their next step. Additionally, we will see the number of resulting papers/presentations at the end of the grant period.

**Higher Education**: "Our Higher Education program's main goal is to give undergraduate students the opportunity to participate in projects and programs that will enhance their

college experience and encourage them to continue on with STEM education and eventually to STEM careers.”

Specific: Create and maintain a hands-on Higher Education program that leaves student participants wanting more.

Measurable: Our goal is for 75 percent of our Higher Ed. students to pursue further STEM education and careers.

Appropriate: Our Higher Ed. program is composed of projects that fit directly into NASA Education Outcomes and Objectives 1.3- Student Involvement, Higher Education.

Realistic: We have sufficient funding set aside in our budget to fund the Higher Ed. projects proposed for the coming grant year.

Time-Specific: We will know whether we have met our goals when each participating (significantly-supported) student finishes his or her current degree and moves on to his or her next step.

**Precollege Education**: “Our goal is for 75 percent of participating teachers to return to their classrooms and use NASA resources. (As per the PART measure.) For teachers who participate in longer program, our goal is for 60 percent to use NASA resources in their classroom instruction.”

Specific: Present teachers and students with opportunities for development in areas.

Measurable: Number of teachers participating and percentage of those who return to their classrooms and use NASA resources.

Appropriate: Our Precollege Ed. program is composed of projects that fit directly into NASA Education Outcomes and Objectives 2.1, 2.3 and 2.4.

Realistic: We have sufficient funding set aside in our budget to fund the Precollege Ed. projects proposed for the coming grant year.

Time-Specific: We will know whether we have met our goals when each participating teachers report back to us whether they are using NASA materials.

**Informal Education**: “The goal for our Informal Education program is to reach out to a diverse group of Tennessee with a message of STEM literacy and awareness of NASA’s mission.”

Specific: Present residents of Tennessee with learning opportunities outside of the classroom.

Measurable: A goal of 60 percent of participants who express increased in STEM areas and NASA at the conclusion of the particular project.

Appropriate: Our Informal Ed. program is composed of projects that fit directly into NASA Education Outcomes and Objectives 3.1- Resources.

Realistic: We have sufficient funding set aside in our budget to fund the Informal Ed. projects proposed for the coming grant year.

Time-Specific: We will know whether we have met our goals when participants demonstrate their increased interest in STEM areas and NASA at the conclusion of their projects.

### **STEM Workforce Development:**

Specific: Support programs that lead undergraduate and graduate students in Tennessee into further education and careers in STEM fields.

Measurable: Our goal is for 80 percent of our student participants in these programs to pursue further STEM education and careers.

Appropriate: Our Workforce Development program is composed of projects that fit directly into NASA Education Outcomes and Objectives 1 and 2.

Realistic: We have sufficient funding set aside in our budget to fund the STEM workforce development projects proposed for the coming grant year.

Time-Specific: We will know whether we have met our goals when each participating (significantly-supported) student finishes his or her current degree and moves on to his or her next step.

#### **Student-Led Flight/Other Student Collaborative Projects:**

Specific: Support student-led projects that lead undergraduate students in Tennessee into further education and careers in STEM fields.

Measurable: Our goal is for 75 percent of our student participants in these programs to pursue further STEM education and careers.

Appropriate: Our Student Collaborative Projects program is composed of projects that fit directly into NASA Education Outcomes and Objectives 1.

Realistic: We have sufficient funding set aside in our budget to fund the STEM projects proposed for the coming grant year.

Time-Specific: We will know whether we have met our goals when each participating (significantly-supported) student finishes his or her current degree and moves on to his or her next step.

#### **Intensive (Summer) Learning for Middle School Students and Educators:**

Specific: Present teachers and students with opportunities for development in STEM areas.

Measurable: Number of teachers participating and percentage of those who return to their classrooms and use NASA resources.

Appropriate: Our Precollege program is composed of projects that fit directly into NASA Education Outcomes and Objectives 2.1, 2.3 and 2.4.

Realistic: We have sufficient funding set aside in our budget to fund the Precollege projects proposed for the coming grant year.

Time-Specific: We will know whether we have met our goals when each participating teachers report back to us whether they are using NASA materials.

### **PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, and 3)**

**Outcome 1:** *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals.*

At East Tennessee State University one female and one male undergraduate student participated in astronomical research programs. The male student has graduated in with a B.S. degree in Physics and has been accepted into a graduate program in Materials Science. He also co-authored a paper published in an online research journal. The female student is still enrolled in her undergraduate degree program. Her participation

contributed to her acceptance into a summer physics research internship at another university.

**Outcome 2:** *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty.*

Anecdotal comments following preservice teacher workshops at The University of Tennessee at Chattanooga show that elementary grades preservice teachers are finding the workshops useful for strengthening their backgrounds in mathematics and science, and are taking additional courses to add the middle grades teaching endorsement. Several middle grades preservice teachers, who are student teaching this semester, have visited to inform our Affiliate Representative of the usefulness of the materials provided for use in the classroom. Students commented on their fall course evaluation that they appreciated the materials, and one student noted that they would like to see the whole course taught as a workshop.

**Outcome 3:** *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission.*

In June 2014, 29 7<sup>th</sup> and 8<sup>th</sup> grade girls attended Engineering a Future – Summer Edition at Tennessee Technological University and stayed on campus for 4 days/3nights, with 8 female engineering students as counselors/role models. They visited several of the engineering labs and participated in multiple hands-on activities, including reactionary rockets, designing and building foam board chairs, and putting together an am radio kit. Eleven of the 29 girls had attended previous Engineering a Future events. Seven of the participants were Hispanic and three were African American. Diversity was also represented among the counselors, with two Hispanic and two African American undergraduate students participating.

## **PROGRAM ACCOMPLISHMENTS**

**Outcome 1:** *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals: (Discussion of achievements and progress related to your Fellowship, Scholarship, Internship, Higher Education and Research Infrastructure programs). (Employ and Educate)*

Fellowship/Scholarship: As stated above in Program Goals, our goal for our Fellowship/Scholarship programs is to have at least 60 percent of our overall Fellowship/Scholarship graduate students join the STEM workforce when their educations are complete. Also, we aim to have 45 percent of our undergraduate participants pursue further STEM education. We do not yet have full data on our 2014-2015 students, but our preliminary data shows that we are on track to meet or exceed our goal. Additionally, 40 students took next steps in FY13.

Research Infrastructure: Our goal for these programs is both to further scientific knowledge in areas of interest to NASA and to give undergraduate and graduate students the opportunity to participate in an actual research experience. We will assess these projects based on whether they produce any papers and/or presentation and whether

participating students continue on a STEM path. For one example of our success in such a workforce development program, our Research Infrastructure program at The University of Memphis has inspired and motivated students to pursue careers in STEM disciplines and to raise student's awareness of NASA's mission. The Tennessee Space Grant funds have been used to financially support undergraduate and graduate students interested in getting hands-on experience in the field of astronautics. The experience contributes to workforce development by engaging students in contemporary applications related to space science and exploration. In addition to Dr. Marchetta's (Affiliate Representative) research, Space Grant funds have been made available to other faculty on campus conducting space-related research. These funds will also be used to support undergraduate research and student travel for participating faculty. Dr. Firouzeh Sabri in the Department of Physics at the University of Memphis has been participating in the Space Grant activities with Dr. Marchetta. The program has emphasized attracting students into the University Honors Program through the space-related research opportunities.

Higher Education: Our Higher Education program's main goal is to give undergraduate students the opportunity to participate in projects and programs that will enhance their college experience and encourage them to continue on with STEM education and eventually to STEM careers. For one example of our success, at Middle Tennessee State University during late 2013 and early 2014, nine Tennessee Space Grant undergraduate researchers used late 2012 Landsat scenes and Census 2010 TIGER/Line road data to map land cover/land use (LCLU) in a 1,500 sq. km (580 sq. mile) area around Mobile Bay, Alabama. Undergraduates are evaluating the accuracy of their LCLU map at hundreds of random locations by examining 2009 air photos and by visiting sites on the ground during early March, 2014. After completing the accuracy assessment, the undergraduates will calculate the amount of urban growth between 2001 and the present within the mapped watersheds. They seek to compare actual growth with estimates made by researchers who used Census 2000 data and 2001 LCLU to predict growth. The team collected reference data around Mobile Bay, AL during the week of March 6-12. The team has communicated some results to Dale Quattrochi and Roberta Swann, NASA MSFC researchers, and plans to communicate more results upon project completion. Mark Abolins and an undergraduate participant presented grant year 2013 results at the 2013 Fall American Geophysical Union Meeting, and all of the undergraduates will contribute to a poster presentation at MTSU Scholars Week Poster Day (April 8). The project contributed to Outcome 1 by training students in GIS, remote sensing, and field data collection. The project contributed to Outcome 2 by attracting nine students to this STEM investigation. The project provided an authentic, hands-on experience in GIS, remote sensing, and field data collection. The students are examining some of the same problems as NASA-funded investigators involved in "The Application of Remotely Sensed Data and Models to Benefit Conservation and Restoration along the Northern Gulf of Mexico Coast" (Maury Estes, PI). The project focuses on environmental science (a NASA 2010 Educational Priority) because it is an examination of the environment of Mobile Bay, AL.

**Outcome 2:** *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty:* (Discussion of achievements primarily focused on your Higher Education programs not discussed in Outcome 1 and your Precollege programs). (*Educate and Engage*)

Higher Education: Our Higher Education program's main goal is to give undergraduate students the opportunity to participate in projects and programs that will enhance their college experience and encourage them to continue on with STEM education and eventually to STEM careers. For one example of our success, Vanderbilt University's Aerospace Club is comprised of engineering undergraduate students. Its activities are funded by the TSGC and the Department of Mechanical Engineering. The Vanderbilt Aerospace Club participates in the NASA-Marshall sponsored University Student Launch Initiative (USLI). This is a year-long effort, involving launch vehicle and payload design, design reviews etc., eventually culminating in a final launch. The Vanderbilt Aerospace Club received a special award from the Tennessee section of the American Institute of Aeronautics and Astronautics for its outstanding success at the NASA University Student Launch Initiative (USLI) National Competition. In addition, the team adviser and Professor of Mechanical Engineering A.V. Anilkumar received the Tennessee AIAA Special Award for outstanding mentoring to the Vanderbilt Aerospace Club. At an awards luncheon at the University of TN Space Institute, the club was commended by AIAA for winning the Payload Design Prize and the Web Site Design Prize at the 2013-2014 NASA USLI Competition. All Vanderbilt Aerospace Club members who graduated in 2013 and 2014 have gone on to further STEM education or employment in a STEM field. This program is part of our emphasis on student-led flight opportunities, as well as an authentic, hands-on student experience in science and engineering disciplines (a NASA 2010 Education Priority).

Precollege: Our goal is for 75 percent of participating teachers to return to their classrooms and use NASA resources. (As per the PART measure.) For teachers who participate in longer program, our goal is for 60 percent to use NASA resources in their classroom instruction. For one example of our success, the NASA SEMAA project at Tennessee State University utilizes a series of unique hands-on, inquiry-based classroom curriculum enhancement activities. In addition to being aligned with national math, science, and technology standards, these activities encompass the research and technology of each of NASA's four Mission Directorates (Aeronautics Research, Exploration System, Science, and Space Operations). On average, NASA SEMAA students participate in this classroom curriculum for a total of thirty-six hours each year, twenty-one hours during the academic year and fifteen hours during the summer. NASA SEMAA graduates who have participated in the entire K-12 curriculum will have completed 441 hours of advanced studies in STEM prior to their enrollment in a post-secondary institution. Over 70% of students participating in Saturday Academies and in the Aerospace Education Laboratory outreach on the TSU campus were from underrepresented groups including African American, Hispanic, and Native American. We involved more than 1500 K-12 students as direct participants in the SEMAA program during this funding period with an additional 2000 in outreach. Evaluations were collected quarterly by 1) the National SEMAA Office, 2) the NASA Aerospace

Education Laboratory, and 3) the NASA NEISS online system. Additionally, in house evaluations were collected for annual reports to NASA, NSF and to Tennessee State University, consisting of both formative and summative evaluations.

More than 1200 high ability students in the Metro Nashville Public Schools Encore program received NASA materials and curricular support from the SEMAA program during this reporting period. Kindergarten through 7th grade students identified as gifted and talented by the MNPS school system attend a 3-hour enrichment session each week during the school year. As in-kind support, the Encore program provided the salaries of the teachers involved in the program during the 2010-2011 school year along with additional supplies needed to effectively implement the NASA SEMAA curriculum. Dr. Leigh Arino de la Rubia coordinated the implementation of the curriculum in this public school initiative.

Head Middle School in Metro Nashville Public Schools held a weeklong half-day SEMAA summer camp in July of 2012 as part of their bridge program for entering 5th graders. Approximately 120 5th grade students attended this program. This program encompasses intensive summer learning for middle school students.

**Outcome 3:** *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission:* (Achievements and progress of Informal Education programs). *(Engage and Inspire)*

Informal Education: The goal for our Informal Education program is to reach out to a diverse group of Tennessee with a message of STEM literacy and awareness of NASA's mission. One example of our success is the Space Outreach Visitations program at The University of Tennessee at Knoxville. Paul Lewis, of UTK's Physics & Astronomy department and a member of our Planetary Geosciences Institute, is largely responsible for this success story of "spreading the word". He has become a true "space science missionary" during his many visits to schools and organizations in East Tennessee each year. Paul is an energetic, industrious person with a tremendous rapport with all these people. In addition, on most clear nights, Paul gives demonstrations and guides the use of our several telescopes on the top of the Physics building. This also is for the public and has received rave reviews from the students and general public alike, including major newspaper and TV coverage. We effectively evaluate the success of this program by the number of persons, especially K-12 students, who are involved, and calls for repeat performances. Important for our space outreach, Mr. Paul Lewis is now a line-item, full-time space outreach lecturer at UTK, whose salary is fully funded by the UTK administration. The number of K-12 schools that have been visit throughout east Tennessee this last year is 21. Each of these visits entailed 1-3 lectures. The average number of students and teachers that were involved at each institution was 35-150 and 2-5, respectively. Additionally, Mr. Lewis visited the Bays Mountain Astronomy Club, Bays Mountain Park and Planetarium, UTK AeroSpace Education Workshop, King College, Kids U Rockets (2), ORION (Oak Ridge Group), Wesley Woods Camp (3), North Star Church, Big South Fork River and Recreation Area (5), Fall Creek Falls State Park (2), Bristol Astronomy Club, Knoxville Observers, O'Conner Senior Center, The



Night Sky non-credit course for adults, Tennessee Spring Star Party, Astronomy Day, International Year of Astronomy activities, StarFest, SouthEastern Planetarium Association Conference (3).

## PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

**Diversity:** *of institutions, faculty, and student participants (gender, underrepresented, underserved)*

As stated above, our goal for the current five year grant period has been for our percentage of awardees who are members of underrepresented groups in our Fellowship/Scholarship, Research Infrastructure and Higher Education programs to meet or exceed the percentage of students from underrepresented groups who are enrolled in Tennessee colleges and universities. As the 2014-2015 grant year is not yet complete, we do not yet have firm diversity statistics. That said, we are on track to meet or exceed our goal. In addition to our two HBCU Affiliate Members (very active participants in the TSGC), our Affiliate Representatives at all of our institutions strive to include qualified diverse individuals in all our activities and programs. Additionally, as also stated above, we are actively exploring the feasibility of adding one or two more HBCUs in our state to our Consortium.

**Minority-Serving Institution Collaborations:** During the 2014 – 2015 grant year we continued to have excellent relationships with Minority-Serving Institutions. Fisk University and Tennessee State University are HBCUs. Several of our other affiliate institutions continue to have active and meaningful collaborations with these schools. These schools also stand well on their own as TSGC Affiliate Institutions. We are exploring the possibility of getting one or two additional HBCUs involved with the TSGC.

**NASA Education Priorities:** *Accomplishments related to the “Current Areas of Emphasis” stated in the 2010 Space Grant solicitation. Report on areas that apply to work proposed in your proposal and budget.*

• Authentic, hands-on student experiences in science and engineering disciplines. We have several programs that fit into this category. For example, we have students participating in NASA Marshall’s USLI Rocket Program from both Fisk University and Vanderbilt University. This competition is formulated to mimic an actual NASA project from beginning to end. Thus, student participants have an experience very close to that of being a NASA employee. Similarly, we support teams at three institutions in NASA Marshall’s Annual Great Moonbuggy Race. These students get to work on the design and construction of a vehicle that is capable of working on our Moon. Additionally, the students we send to summer programs at various NASA Centers have the opportunity to participate, alongside their mentors, in actual NASA scientific and engineering projects.

•Engage middle school teachers in hands-on curriculum enhancement capabilities. Our preservice workshops at The University of Tennessee at Chattanooga have helped participating future middle school teachers gain knowledge and skills in mathematics, science, and technology. Standards-based project components included: (a) three Challenger Center missions; and (b) NASA and STEM educational materials integrated into four additional workshops (K'nex Middle Grades Math, Zometool Middle Grades Math, Robotics, Math and Science Literature).

•Summer opportunities for secondary students on college campuses. At Tennessee Technological University, Engineering a Future and Engineering a Future, Summer Edition brings middle school girls to campus. The Summer Edition is a four-day camp on the Tennessee Tech campus, chaperoned by female engineering students. These students also serve as role models to the participating girls. This program is directly aimed at increasing female enrollment in engineering. A recurring theme in the essays written by the girls who want to take part in our summer workshop is that they all like Math and Science and want to learn more about the engineering field and new career opportunities. The overall purpose of these programs is to educate young girls on specific STEM content areas (the various disciplines of Engineering) and to inspire them to join the nation's future engineering workforce.

•Environmental Science and Global Climate Change. At Middle Tennessee State University students, along with their professor, have been working on mapping of land cover/land use in three watersheds in the Mobile Bay, Alabama area. This is particularly important work in light of all the current extreme weather events that have been occurring in this particular area of the country.

## IMPROVEMENTS MADE IN THE PAST YEAR

Our Consortium has essentially maintained the structure and practices that have enabled our success during the past several years. As always, we strive to work as a unified Consortium to meet our goals and objectives at our individual Affiliate Institutions, as a statewide body and in concert with national priorities. Additionally, we are working towards the goals set forth in our Improvement Report. Specifically, we are developing a common, Consortium-wide application for our Fellowship/Scholarship programs and we are planning to re-administer the Affiliate Survey to our Affiliate Representatives in the near future.

## PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

Vanderbilt University, Lead Institution. National private research university granting degrees through the Ph.D.

Austin Peay State University, Affiliate Institution. Public master's level university.

Columbia State Community College, Affiliate Institution. Two-year public community college granting Associate's degrees.

East Tennessee State University, Affiliate Institution. Public Ph.D. level university.

Fisk University, Affiliate Institution. HBCU. Private master's level university.  
Middle Tennessee State University, Affiliate Institution. Public Ph.D. level university.  
Oak Ridge Associated Universities, Affiliate Institution. A consortium of 99 doctoral-granting academic institutions.  
Rhodes College, Affiliate Institution. Private undergraduate liberal arts college.  
Tennessee Education Association, Affiliate Institution. Statewide representative body of K-12 educators.  
Tennessee State University, Affiliate Institution. HBCU, Land-grant school. Public Ph.D. level university.  
Tennessee Technological University, Affiliate Institution. Public Ph.D. level university.  
The University of Memphis, Affiliate Institution. Public Ph.D. level university.  
The University of Tennessee at Chattanooga, Affiliate Institution. Public Ph.D. level university.  
The University of Tennessee at Knoxville, Affiliate Institution. Land-grant school. National public research university granting degrees through the Ph.D.  
The University of Tennessee Space Institute, Affiliate Institution. Public Master's and Ph.D. level school. Only confers graduate degrees.